NOLAN WAGENER

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Research Interests

Machine learning for robotics, reinforcement learning, model predictive control.

Citizenship

United States, Canada

Education

Georgia Institute of Technology 2015–Present
PhD Candidate, Robotics
School of Interactive Computing
Advisors: Byron Boots and Panagiotis Tsiotras
Thesis: *Machine Learning for Safe and Effective Robotic Control*

University of California, Berkeley 2010–2014
BS, Electrical Engineering and Computer Science
BS, Mechanical Engineering

Employment

University of Washington September 2021 – Present
Research Scientist
Paul G. Allen School of Computer Science & Engineering
Led development of the control stack for the DARPA RACER project

Microsoft Research May 2021 – August 2021
Reinforcement Learning Research Intern
Mentors: Matthew Hausknecht and Ching-An Cheng
Studied use of GPT transformers for human motion completion in MuJoCo physics simulator

University of California, Berkeley May 2014 – January 2015
Postbaccalaureate Research Assistant
Department of Electrical Engineering and Computer Science
Mentors: Sergey Levine and Pieter Abbeel
Wrote low-level code for the PR2 and Baxter robots for learning contact-rich manipulation skills

Awards and Honors

NeurIPS Scholar Award	2022
NeurIPS Top Reviewer	2022
NeurIPS Datasets and Benchmarks Track Outstanding Reviewer	2022
RSS Best Student Paper Award	2019
RSS Best Systems Paper Award, Finalist	2019
ICRA Best Conference Paper Award, Finalist	2017
NSF Graduate Research Fellowship	2015–2020
ICRA Best Robotic Manipulation Paper Award	2015
UC Berkeley Mechanical Engineering Department Citation, Honorable Mention	2014

Publications

Refereed

[1] Xiangyun Meng, Nathan Hatch, Alexander Lambert, Anqi Li, Nolan Wagener, Matthew Schmittle, JoonHo Lee, Wentao Yuan, Zoey Chen, Samuel Deng, Greg Okopal, Dieter Fox, Byron Boots, Amirreza Shaban. **TerrainNet: Visual Modeling of Complex Terrain for High-Speed, Off-Road Navigation**. Robotics: Science and Systems (RSS), 2023.

[2] Nolan Wagener, Andrey Kolobov, Felipe Vieira Frujeri, Ricky Loynd, Ching-An Cheng, Matthew Hausknecht. **MoCapAct: A Multi-Task Dataset for Simulated Humanoid Control**. Neural Information Processing Systems (NeurIPS), 2022.

[3] Nolan Wagener, Byron Boots, Ching-An Cheng. **Safe Reinforcement Learning Using Advantage-Based Intervention**. International Conference on Machine Learning (ICML), 2021.

[4] Adam Foris, Nolan Wagener, Byron Boots, Anirban Mazumdar. **Exploiting Singular Configurations for Controllable, Low-Power Friction Enhancement on Unmanned Ground Vehicles**. IEEE Robotics and Automation Letters (RA-L), presented at ICRA, 2020.

[5] Nolan Wagener*, Ching-An Cheng*, Jacob Sacks, Byron Boots. **An Online Learning Approach to Model Predictive Control**. Robotics: Science and Systems (RSS), 2019.
Winner of Best Student Paper Award
Finalist for Best Systems Paper Award

[6] Ching-An Cheng, Xinyan Yan, Nolan Wagener, Byron Boots. **Fast Policy Learning Through Imitation and Reinforcement**. Uncertainty in Artificial Intelligence (UAI), 2018.
Plenary presentation

[7] Grady Williams, Nolan Wagener, Brian Goldfain, Paul Drews, James Rehg, Byron Boots, Evangelos Theodorou. **Information Theoretic MPC for Model-Based Reinforcement Learning**. IEEE International Conference on Robotics and Automation (ICRA), 2017.
Finalist for Best Conference Paper Award

[8] Sergey Levine, Nolan Wagener, Pieter Abbeel. **Learning Contact-Rich Manipulation Skills with Guided Policy Search**. IEEE International Conference on Robotics and Automation (ICRA), 2015.
Winner of Best Robotic Manipulation Paper Award

Non-Refereed

[1] Matthew Hausknecht, Nolan Wagener. **Consistent Dropout for Policy Gradient Reinforcement Learning**. 2022.

Invited Talks

"TerrainNet: Visual Modeling of Complex Terrain for High-Speed, Off-Road Navigation", RSS Talk, 2023
"MoCapAct: A Multi-Task Dataset for Simulated Humanoid Control", NeurIPS Virtual Talk, 2022
"MoCapAct: A Multi-Task Dataset for Simulated Humanoid Control", University of Toronto AI in Robotics Seminar, 2022
"Model Predictive Control for Aggressive Off-Road Driving", University of Washington EE P 545 (The Self Driving Car: Intro to AI for Mobile Robots) Invited Lecture, 2021
"Safe Reinforcement Learning Using Advantage-Based Intervention", Microsoft Research Summit, 2021
"Safe Reinforcement Learning Using Advantage-Based Intervention", ICML Virtual Talk, 2021
"An Online Learning Approach to Model Predictive Control", RSS Talk, 2019

Service

Reviewer for RSS, ICRA, IROS, ICML, NeurIPS, IEEE RA-L, Artificial Intelligence

Teaching Experience

Teaching Assistant for CS 3600 (Artificial Intelligence), Georgia Tech	2020
Teaching Assistant for CS 8803 ACRL (Adaptive Control and Reinforcement Learning), Georgia Tech	2019
Teaching Assistant for CS 4641 (Machine Learning), Georgia Tech	2018

Membership

IEEE, Phi Beta Kappa, Tau Beta Pi

Skills

Programming Languages Python, C++, MATLAB
Libraries PyTorch, Isaac Gym, MuJoCo, PyBullet, `dm_control`, ROS

Selected Projects

DARPA Robotic Autonomy in Complex Environments with Resiliency (RACER) September 2021 – Present

- Lead of the controls team
- Architectured the control stack for a modified Polaris RZR vehicle
- Provide guidance and advice for development of the controls stack

MoCapAct: A Multi-Task Dataset for Simulated Humanoid Control May 2021 – October 2022

- Wrote large portions of the code for the project, including training for clip-tracking experts, generation of the rollout dataset, and reinforcement learning for downstream tasks
- Coordinated launching and analysis of large-scale experiments with colleagues at Microsoft, with an equivalent of 50 years wall-clock time to run all experiments
- Led meetings and established milestones of the project

Scalable, Adaptive, and Resilient Autonomy (SARA) May 2020 – May 2021

- Wrote an efficient implementation of model predictive path integral (MPPI) in C++ using the Eigen library (average optimization time of 7 milliseconds when using 1000 parallel samples per iteration and a planning horizon of two seconds)
- MPPI code is capable of driving Clearpath Warthog at speeds up to 3.7 m/s (8.3 mph) while navigating around obstacles

Value Function Learning for Simulated Racing August 2019 – December 2019

- Formulated a soft model predictive control algorithm (here, MPPI) in a soft reinforcement learning setting, allowing for value functions to be trained by and used with MPPI
- Extended the MPC PyTorch framework to support value function training, including batch generation of value function targets using a batch version of MPPI (i.e., simultaneously solving a batch of optimal control problems using PyTorch's batch operations)
- Within a simulated racing task, showed that a combination of a learned value function and a short planning horizon for MPPI can decrease lap times compared to using MPPI without a terminal value function

An Online Learning Approach to Model Predictive Control September 2018 – May 2019

- Formulated a connection between sampling-based model predictive control (MPC) and online learning, resulting in an algorithm (DMD-MPC) which admits several special cases (natural gradient descent, cross-entropy method (CEM), model predictive path integral (MPPI))
- Wrote a framework in PyTorch containing numerous sampling-based MPC algorithms (MPPI, CEM, DMD-MPC)
- Conducted experiments on AutoRally platform (1:5 scale off-road vehicles) showing that a variant of MPPI derived from DMD-MPC outperforms the original version of MPPI when working with a small computation budget (i.e., number of samples per MPC update)

Learning Contact-Rich Manipulation Skills with Guided Policy Search June 2014 – January 2015

- Wrote realtime controller for PR2 and Baxter robots to execute controller (linear, time-varying controller or neural network) given by remote MATLAB program and send relevant data back to that program
- Conducted experiments on the PR2 and Baxter involving insertion tasks (e.g., putting together giant Lego blocks, attaching wheelbase to toy airplane)
- Wrote vision code to change desired insertion location when target item (e.g., bottom Lego block) is moved